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For in the beginning the Lord made Heaven and Earth, and He took a bit of each and set them down on this part of Alberta; now known far and wide as The Big Country.

—T. W. DOWSON,
Production Manager, CJDV.

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VALLEY OF THE DINOSAURS

Prepared by DR. W. R. READ

A visitor approaching the city of Drumheller is suddenly confronted by a mile wide valley where the Red Deer river has excavated below the prairies of Central Alberta to a depth of nearly four hundred feet. Travelling from Calgary via No. 9 Highway the first intimation of an abrupt change in terrain occurs at Horseshoe Canyon Lookout ten miles southwest of the city of Drumheller. Horseshoe Canyon is only tributary to the Red Deer valley and the scenery here is but a preview of the magnificent vistas that await in the main canyon between Drumheller and Trochu ferry. The grandeur of the multicolored, sculptured walls of the valley, as viewed from the Dinosaur Trail between Drumheller and Munson ferry, is unexcelled elsewhere in Canada. Here are world famous Badlands of Alberta.

The Red Deer valley is the result of erosion. The Red Deer river has required only a few thousand years to carve the badlands, but in the process it has revealed a chapter in the history of the earth that was written in the rocks seventy-five million years ago and when deciphered by geologists rivals the best of science fiction.

FOSSILS LIFT THE VEIL OF TIME

Life on our earth has passed through many stages between its birth in the remote past and its present day expression. Great races of creatures arose and flourished for many millions of years and became extinct leaving only their remains as mute evidence of their existence. These remains are called fossils and they comprise bones and tracks of ancient animals, as well as impressions of leaves and petrified wood buried in the rock of the earth's crust.

Although fossil remains were known to exist as early as 450 B.C., for many centuries they were deprecated as devices planted by the devil to delude man. Another conviction held was that fossils were "relics of that accursed race that perished with the flood." But by the turn of the 19th century a few pioneer students of the earth, geologists (the early geologists were more stone masons than scientists) noticed that a relationship existed between certain layers of rocks and the fossils which they contained. Each layer seemed to have its own characteristic plant and animal remains. These men began to sense dimly vast expanses of time punctuated here and there by profound changes in life, topography and climate. Slowly they began to piece together the petrified bits and pieces into a picture of the life of millions of years ago. Thus was born the science of paleontology, the study of ancient life. Paleontology is an adjunct of geology, the broader science that investigates the structure and history of the earth and in a practical way discovers and exploits all kinds of economic mineral resources including oil, coal, iron and gold and so on.

There are many things of interest in the Red Deer valley for the geologist. For the paleontologist the badlands are a veritable storehouse of fossils which is easily accessible to the amateur fossil hunter as well as the professional collector. A few hours spent exploring the coulees of the valley will prove stimulating and rewarding to anyone who follows the Dinosaur Trail and visits the local museum.

This earth is perhaps three billion years old. So far as paleontologists can tell the first living things appeared on earth about two billion years ago. For a long time after that, possibly one and a half billion years, the only animals were relatively insignificant creatures such as sponges, jellyfish, snails, clams, worm and crab-like beasts, but no animals with backbones appeared until about four hundred million years ago. These first animals with backbones were the fishes which were soon followed by creatures that could breathe air and spend part of their lives out of the water, in other words: amphibians, whose living descendants are the frogs, turtles and salamanders. A little later some amphibians became entirely divorced from their life in the water, developed dry, scaly skins and thus became the first reptiles.

The reptiles soon dominated the land and ushered in the Age of Reptiles. This age is known technically as the Mesozoic Era and lasted about 130 million years. It came to a close about 65 million years ago with the final extinction

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of the great dinosaurs and most of their lesser allies. Of the reptiles only the turtles, lizards, snakes, crocodiles and the tuatara have survived to modern times. The Age of Mammals in which we live followed the demise of the dinosaurs. The great Ice Age, of which we speak so glibly in terms of long ago, in fact occurred within the last million years and according to some is still with us.

Where in this long history do the rocks in the Red Deer valley fit and how did they come to be?

GEOLOGY

The most abundant rocks in the valley walls are composed of alternate bands of black, brown, grey and white layers of coal, clay, ironstone, shale and sandstone. These rocks are called the Edmonton formation by geologists and the fossils they contain tell us that they date from near the end of the Age of Reptiles, a time known to geologists as the Cretaceous Period. In a few places light grey yellow cliffs can be seen above the darker colored Edmonton rocks and these belong to the Paskapoo formation which was laid down some 60 to 65 millions years ago at the beginning of the Age of Mammals. Still higher in the bluffs, right up to the prairie's edge and "on top" are yellow gravels, sand and silts which date from sometime in the great Ice Age or Pleistocene Epoch. These sediments are only a few thousand years old and evidently formed in lakes that lay upon the land when the broad glaciers were melting away. The regularly banded yellow silts which can be seen along the highway as it begins its descent towards Drumheller were deposited in old Lake Drumheller which is estimated to have covered an area of approximately eleven hundred square miles. Lake Drumheller was dammed by glacial ice that melted more slowly to the south, but when the ice dam finally disappeared the old lake was drained and the final sculpturing of the Red Deer valley commenced. This occurred only a few thousand years ago. The rim of hills at the prairie level are composed of sand and gravel that was dumped from glacial streams as the melting ice caused their channels to collapse.

What occurred between the end of the Age of Reptiles and the Ice Age is little known in the Drumheller district. Sediments probably continued to be deposited here off and on for the 65 million years of the Age of Mammals, but the glaciers so gouged the surface of the earth that they carried away mile after mile of more recent rocks. Thus was destroyed most of the record in the rocks except those from the very earliest times in the Age of Mammals, which are still preserved in the Paskapoo formation.

THE EDMONTON FORMATION

The colorfully banded layers of the Edmonton formation were deposited by meandering rivers in shallow lakes and lagoons and flood plains. Layer upon layer of mud, clay, silt and sand piled up over thousands of years to a depth of hundreds of feet. In the ensuing millions of years these sediments were cemented and compacted into the hard rocks they are today.

It is a distinctive feature of these rocks that they contain large quantities of the mineral bentonite which is derived from the chemical weathering of volcanic ash. At times, thin but very extensive layers of white volcanic ash were apparently deposited directly in shallow bodies of water covering much of the Central Alberta and Saskatchewan region. This material called the Kneehills tuff in the Drumheller area is very hard and forms a thin white "cap rock" at the rim of Horseshoe Canyon. According to geologists the ash itself was evidently spewed out of volcanoes which erupted to the south in what is now the state of Montana.

Most of the sand and mud that forms the Edmonton formation was derived from the erosion of highlands to the west. The Rocky Mountains had begun to rise in the closing phases of the Mesozoic Era (Age of Reptiles) under the influence of what seems an almost unimaginable warping of the American continent. Off and on for hundreds of millions of years a vast inland seaway had joined the Gulf of Mexico and the Arctic Ocean across what now are the prairie states and provinces. Some deposits from this arm of the sea called the Bearpaw formation can be seen southeast of Drumheller where brown shales form the base of the stems of the Hoodoos at Willow Creek. Fossil

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oyster shells in the Edmonton formation are apparently derived from this inland sea which briefly inundated some of the lowlands at several times during deposition of the Edmonton sediments.

At the very end of the Age of Reptiles the warping of the continent combined with erosion to cause the final retreat of this great seaway from North America. By this time the last of the Edmonton rocks had been deposited.

The Edmonton formation is of great interest because of the wealth of dinosaur bones which it contains. But dinosaurs are not the only fossils in these rocks. Also present are remains of various less spectacular creatures including sharks, alligators, gars and other fishes, salamanders, turtles, lizards, crocodiles and an almost unbelievable sea-monster called a plesiosaur. At several places there are layers of ancient oyster shells and besides coal deposits there are remains of a great variety of plants and petrified tree trunks.

ALBERTA 70 MILLION YEARS AGO

Scientific analysis of the geological and paleontological evidence afforded by the Edmonton formation and its fossils permits the following impressions of what Alberta was like some 70 million years ago.

Where flat prairie land now rises gradually toward the ancient Rocky Mountains a broad swampy delta formed along the edges of the inland sea that stretched north-westward from the Gulf of Mexico. Where the Red Deer river now cuts its canyon there were then broad and meandering streams with backwaters bordering on the stagnant, which in places produced swamps where vegetation decayed in the first stages of coal formation. These lowlands were periodically flooded and occasionally for several years at a time the sea drowned some of the river mouths. Wide savannas reached inland onto higher ground.

Where now temperatures range from 110 degrees above zero to 50 degrees below and the countryside is swept unmercifully by winter blizzards, the climate was then uniformly subtropical and the ground never froze in the winter. Where now trees worthy of the name exist only in sequestered places, then there lived a "forest primeval" composed of tall redwoods, cypresses, sable palms, plane trees, gingkos and others that today occur only in subtropical climates.

In this setting instead of herds of cattle, sheep and occasional families of antelope there lived hordes of armoured and duck-billed dinosaurs. The variety of these creatures is almost beyond imagination. Armoured dinosaurs resembling horned toads as big as trucks moved sluggishly about the countryside. Fleeter dinosaurs the size of ostriches ran about on long hind legs in search of seeds, flies, insects or perhaps eggs. Always in the background lurked the possibility of sudden crushing death administered by gigantic carnivorous dinosaurs which were among the most devastating destroyers nature has ever devised. Streams and lakes were populated, in addition to the ubiquitous duckbill dinosaurs, by crocodiles, turtles and fishes, many of which were possibly indistinguishable from their descendants in the present day everglades. And in the trees or wherever else protection could be had from the fearsome brutes of the reptile world, there lived the tiny possum-like creatures, "the advance guard" of the furry minions destined a few million years hence, to inherit the world.

DINOSAUR DISCOVERIES

The most famous petrified remains found in the Drumheller Badlands are the dinosaur bones. While one may find abundant petrified wood, fossil shells, berries, cones and even whole beds of fossil oysters, it is the dinosaur remains that have made the area famous among paleontologists the world over.

In the summer of 1884, Dr. J. B. Tyrrell was dispatched by the Dominion Geological Survey to investigate reported occurrences of coal in the Red Deer river valley. While thus engaged he discovered the head of a petrified monster exposed in a hillside near Kneehill Creek. Dr. Tyrrell sent this and other specimens to Ottawa and Philadelphia for study, and as is usual in scientific research the results of the study were not published until several years afterwards. In 1897 the Drumheller district was visited by a paleontologist, Mr. Lawrence M. Lambe, of the Geological Survey of Canada. In 1910, Barnum

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On The Dinosaur Trail

Brown of the American Museum of Natural History of New York led the first organized expedition for dinosaurs into the valley between the Trochu ferry and the city of Drumheller. He returned in 1911 and in 1912 to complete his work in the Edmonton formation, and in the three years collected an exceptionally fine series of dinosaur skeletons and skulls. In 1912 also, the world famous fossil hunter, Mr. Charles H. Sternberg explored the area accompanied by his sons, Levi, Charles M. and George. On August 12 of that year, Charles M. Sternberg discovered a large duck-billed dinosaur skeleton on Michichi Creek which was later assembled at the National Museum in Ottawa and became the first dinosaur skeleton to be mounted in a Canadian museum. Although C. H. Sternberg continued to search for dinosaurs in the fossil fields of Canada for several years, he never returned to the Drumheller district. His three sons, however, conducted no less than thirteen expeditions in the general vicinity of Drumheller, Munson, Morrin, Trochu and Ardley. By far the most frequent visitor to the district was Dr. Charles M. Sternberg who between 1923 and 1947, conducted six expeditions into the valley on behalf of the National Museum of Canada.

As recently as 1955-56 a dinosaur skeleton was excavated by the National Museum of Canada near Munson ferry and although the specimens are perhaps less easily discovered now than in earlier years, there is no evidence that the supply of fossils in the valley is becoming exhausted.

Since the first discoveries were made three quarters of a century ago nearly thirty fairly complete dinosaur skeletons have been obtained from the Red Deer valley north of Drumheller. Many of these were new to science and have been duly recorded in technical literature that runs to many hundreds of pages.

The best collection of dinosaur skeletons and skulls from the Drumheller district may be seen in the Royal Ontario Museum in Toronto, the American Museum of Natural History in New York and the National Museum of Canada in Ottawa. Skulls and partial skeletons of other "Drumheller" dinosaurs are preserved in the Chicago Natural History Museum, the British Museum of Natural History in London, and in several North American and European university collections.

DINOSAURS

Cold stone fossil beds tell us nearly all we know about the dinosaurs. These extinct reptiles however, were once the dominant wild animals throughout about 130 million years of earth history. The last of them died perhaps 65 million years ago when the warm-blooded mammals finally inherited the earth.

The first dinosaurs evolved from small alligator-like beasts some 200 million years ago. At first, the dinosaurs were small slender-bodied animals quite different from the gigantic behemoths of later times. The first dinosaurs were probably flesh-eating animals, but eventually some of these became more omnivorous in diet and later some of these became specialized to an herbivorous diet. The first dinosaurs were evidently bipedal animals, but when as a group they became heavier of body they tended to walk on all fours as their distant ancestors have done. A few dinosaurs, both of the herbivorous and carnivorous kinds, later became bipedal again; in fact it is not certain that the carnivorous dinosaurs ever passed through a completely quadrupedal stage in their evolution.

During the Age of Reptiles, the dinosaurs and their allies managed to become fitted for making a living in almost every conceivable fashion that was available on the earth of their time. For example, while dinosaurs ruled the land some other reptiles took to the sea and others even invaded the air spaces to become the well known Pterodactyls.

The greatest part of the Age of Reptiles had already passed before the Edmonton formation was deposited in Alberta. Most people think of dinosaurs as huge four-legged creatures with long necks and tails and tiny heads, but in fact this kind of dinosaur called sauropods had largely disappeared before any of the Canadian dinosaur beds were deposited. True sauropods still lived in the southern hemisphere and even in the southern parts of the United States (albeit in small numbers), but no remains of sauropods have ever been found in Canada, nor are they likely to be found here.

Many different kinds of dinosaurs however, did exist in the region now traversed by the Red Deer river. Those from the Drumheller district can be



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grouped roughly into the carnivorous and herbivorous kinds. As usual in nature there were fewer carnivorous than herbivorous ones and these consisted of huge bipedal beasts 35 feet in length and of small animals perhaps no larger than a good sized dog. Of the smaller varieties we know very little because their fossil remains are rare and when found consist usually of teeth and isolated broken bones. The larger carnivorous dinosaurs were exemplified by *Albertosaurus* which was an ancestor of the world famous *Tyrannosaurus rex*.

Albertosaurus had a short neck and body, a long tail, huge head with a mouth full of sabre-like teeth four inches long and powerful hind legs with feet which resembled those of a turkey. The front legs were by contrast so small as to appear practically without function.

Constructed along similar lines but more slender of body and only about nine feet in length was the ostrich mimic dinosaur called *Struthiomimus*. Its bone structure tells us that *Struthiomimus* was a true carnivorous dinosaur by descent but it had become adapted to another mode of life. Instead of the powerful jaws armed with fearsome teeth its feeding mechanism was weak and teeth had been replaced with a horny bird-like beak. Its neck was relatively long and slender. Its hind legs were long and slender. The front legs were longer in proportion than they were in its larger carnivorous colleagues. The food of *Struthiomimus* is somewhat of a mystery. Perhaps it consisted of fruits, berries, insects, eggs, either one or all. One thing is certain, it was a very agile and swift moving animal which resembled an ostrich without feathers.

The plant-eating dinosaurs can be divided into several groups including the duck-billed, horned, armoured and others.

The duck-billed dinosaurs were by far the most common animal of their day in the Drumheller district. One species called *Edmontosaurus* was nearly 30 feet long. It had a long tail, which was flattened from side to side, heavy hind limbs, short front legs and a moderately long and slender neck. Its head was not unusually small as dinosaur heads go and the jaws contained batteries of specialized teeth. There were perhaps a thousand or more teeth present in the mouth of a single animal, although only around two hundred of these were in use at any one time during its life. The other teeth were held in reserve and came into use as the ones above them were worn off. As the name implies, the duck-billed dinosaurs have a peculiar toothless snout which when viewed from different angles reminds one of the bill of a duck. These animals were presumably sluggish beasts which spent most of their time in pools of the great Edmonton delta, both in order to escape the fearsome *Albertosaurus* and also literally to take the weight off their feet. These animals weighed several tons and the bones were constructed so that probably they could not support the weight of the body on dry land for very long at a time. Usually, skeletons of the duck-billed dinosaurs are found lying on their sides with the

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head thrown back, the forelimbs dangling in front of the body, the tail extended out in a more or less straight fashion behind and the legs strongly flexed suggesting a swimming position. In many cases we have found impressions of the skin preserved in the rocks around their bones so we know that the hide of the duck-billed dinosaur was composed of scales which were arranged in various ornamental ways. We do not of course know anything about the color of the "skin" or of the coloration of any other dinosaur for that matter.

Edmontosaurus was not the only duck-billed dinosaur of this region. There were other, both larger and smaller, which had strangely developed heads. Whereas the bodies of the duck-billed dinosaurs were pretty much alike, the tops of the heads of the different species differ greatly from one another. For example, the head of Edmontosaurus was flat on top but some of its close relatives had greatly swollen foreheads and one had a long spike that projected backwards above the neck.

Typical of the horned dinosaurs were the swamp-dwelling creatures called Anchiceratops. This animal was not quite as large as an elephant but probably weighed a couple of tons. It walked on four massive legs of which (as in all dinosaurs) the hind ones were much longer than those in front. The tail was short for a dinosaur and was possibly carried off the ground. There was practically no neck, in fact some of the bones in the neck had solidified into a single mass in order to strengthen the support for the gigantic head. Anchiceratops and the other horned dinosaurs were unusual among dinosaurs in having heads of tremendous size. In Anchiceratops the head accounted for almost a quarter of the length of the animal's body. It consisted of a sharp hooked beak that resembled that of a turtle, a fairly long face and, behind, a broad sheet of bone formed an ornamental shelf of frill that projected over the shoulder region. There was a small horn on top of the beak above the nose and a larger one over each eye. The teeth resembled those of the duck-bill dinosaurs, but were less numerous. The jaws were extremely powerful.

Whereas the duck-billed dinosaurs were evidently defenceless away from the water, the horned dinosaurs presumably could give a good account of themselves in any encounter with Albertosaurus or his unfriendly relatives. For, not only did the bony frill behind the head protect the front part of the body from frontal attack, the horns bore at the unprotected belly of the great flesh-eaters, which it will be recalled walked on their hind legs with the front part of the body well elevated.

There were many different kinds of "horned" dinosaurs (some of which it may be noted did not have horns) but not many are found in the Drumheller area. A very small species has been found upstream from the town of Trochu and the ancestors of the famous Triceratops is known to occur in the Edmonton rocks near Morrin ferry.

The other great group of dinosaurs were the armoured forms. Imagine a modern day "horned toad" 20 feet long and five or six feet wide and you will have a fair idea of what these pre-historic tanks must have looked like in life. Their bodies were low and broad and supported by pillar-like legs, which instead of long slender toes and claws had feet that probably resembled large land tortoises of today with stubby hook-like ends of the toes. The upper side of the body was covered with a mosaic of horny plates and along the sides were curved spikes which became very large and heavy in the region of the shoulders. The heads of armoured dinosaurs were small and completely covered with thick bony plates above and on the sides. The tail was long and so stiffened by bony rods along the sides of the vertebrae that it was evidently rigid at least in its back portion. At the end of the tail were large almond-shaped chunks of bone which fitted together to form a club-like structure. This tail in life must have resembled a gigantic mace. One can imagine that such a creature was partly immune to attacks by Albertosaurus; when danger threatened it may simply have squatted down and swept its tail back and forth in a broad arc behind it. Conceivably the tail club could have cut the feet of a carnivorous dinosaur completely out from under him. In this connection it is interesting to note that many shin bones of carnivorous dinosaurs show the results of severe injuries during life.

Many armoured dinosaurs had their teeth greatly reduced in size and numbers and evidently depended on a horny beak and tough cheek pads to obtain their food which consisted probably of low, soft leafy plants.

All of these dinosaurs lived in or close to bodies of water. They were

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lowlanders. On higher ground there existed other dinosaurs about which we know very little because their carcasses seldom were buried where they could become fossils. One that is worthy of mention is the bony headed dinosaur, *Stegoceras*. The roof of the skull was composed of a great sphere of solid bone, the function of which is still a mystery to paleontologists. The skull bones are fairly common fossils because they were so solid they have resisted disintegration better than the rest of the skeleton which was a fairly delicate affair. The *Stegoceras* was not a large dinosaur, possibly a length of no more than three feet.

So much for the common dinosaurs of the Drumheller valley. There were others but we know very little about them. They were relatively insignificant in number. Many and varied ancestors of these Drumheller dinosaurs are found as fossils elsewhere in Canada. The famous *Triceratops* and *Tyrannosaurus* which are descended from dinosaurs from the Drumheller area are known to occur farther upstream on the Red Deer river. These animals were among the very last of the dinosaurs and as yet no very complete specimen of either has been discovered in Alberta.

HOW ARE DINOSAUR SPECIMENS COLLECTED?

It is a popular misconception that the fossil hunter finds his bones by digging for them. Nothing could be more futile. The proverbial needle in the haystack would be much easier to discover than a dinosaur in the Drumheller valley if this were the method employed by paleontologists. Fortunately the fossil hunter has the assistance of Mother Nature and the processes of erosion expose the fossil bones to view in just the same way as it exposes the rocks which surround the fossils. When the paleontologist enters an area of erosion his eyes are glued to the ground, while he prospects for fragments of broken fossil bone that have been brought to the surface through the various processes of erosion. Usually, when such fragments are discovered careful investigation will lead only to the discovery of a piece of a bone; a vertebrae or two, possibly a leg, a foot, a skull, but only occasionally does such a prospect lead to the discovery of a complete skeleton. It may require many days, weeks or even months of tedious prospecting to discover a complete dinosaur skeleton such as those to be seen on display in many large museums all over the world.

At some places there occur accumulations of bones of dinosaurs and other animals piled helter skelter in a fairly restricted area. These deposits are known as bone beds and may not contain material that is suitable for museum displays. A well exposed bone bed of this type occurs east of Morrin ferry. There are others on the west side of the Red Deer river north of Munson ferry. These bone beds apparently resulted from the washing about of decaying dinosaur carcasses on the shores of ancient bodies of water and they indicate that for some reason a large number of animals died at approximately the same time.

Once a favorable prospect has been discovered a great deal of work in the form of physical labor is required to remove the specimen from its burial place to the museum. This may require excavation with shovels and picks. Sometimes even dynamite judiciously employed is brought into play. It may be necessary to remove tons of rock from above the skeleton in order that the paleontologist may uncover the bones and once the excavation has progressed to the point where the bones are almost exposed then the heavy tools are discarded in favor of such implements as small awls, hammers and chisels, whisk brooms and paint brushes and the like. The bones of the skeleton are outlined with these more delicate implements and as each new area of bone is exposed to the air it must be treated immediately with solutions such as shellac which will harden the bone and protect it against the drying effects of the atmosphere. This may sound strange if the bones are actually petrified or turned to stone, but as a matter of fact freshly exposed fossil bones are often most brittle and soft and the drying effects of the air produces very unfavorable results in many cases. Of course the bones cannot be completely freed from the rock in the field. This is a time consuming operation that can only be accomplished in the museum laboratory.

As soon as the bones have been fairly well exposed on the upper side, trenches a foot or so wide are dug all around the bones so that in effect the bones are left resting on a pedestal of the original rock. Then the bone exposed



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in the upper side of the pedestal is covered with wet tissue paper, and on top of the wet tissue paper are laid bandages made of strips of burlap dipped in plaster of paris and wrapped or in much the same fashion as a doctor would place a plaster cast on a broken arm. If the bones are large it may be necessary to emulate the doctor more closely by employing splints which are usually made of any sort of wood that can be obtained in the vicinity of excavation. As soon as the plaster jacket on the upper side of the pedestal has hardened the rock is cut away from the under side and the plaster jacket containing the bones and upper part of the pedestal is turned over and the same procedure is repeated on the under side. The result of this work is a fossil bone completely encased in a plaster of paris cast which, if it is properly made, should protect the bone during its transportation from the field to the museum and the bone should arrive at the museum in the same state of preservation in which it was removed from the ground. Once the fossil has been received in the museum laboratory the upper half of the protective plaster is cut away and the bone is again hardened and strengthened by the application of various solutions. The rock that still remains adherent to the bone is carefully chipped, scraped or ground off. The broken pieces of bone are removed and cleaned and then are fastened back together with various types of glue and plaster. In the case of long bones sometimes it is desirable to drill holes through the centres and insert iron rods, wires or some other means of strengthening the fossils internally and then they are put together with plaster. This procedure is referred to as preparation. After the fossil bones have been prepared they are then studied, identified and classified by the paleontologist. If they are of scientific interest the paleontologist usually prepares a highly technical report which is published in some professional journal and announces to the scientific world the discovery of a new creature or some interesting fact about an extinct animal that had not been previously known to science.

If the specimen is exceptionally good it may then be placed on display in a museum where the public as well as the scientist can take advantage of it and this is the way in which the magnificent dinosaur skeletons in many of the world's large museums have come to reside in exhibition halls. In mounting a dinosaur skeleton a tremendous amount of work is involved from a purely engineering point of view. Because the bones are extremely heavy and at the same time are exceedingly fragile it is necessary to support them on iron work or scaffolding which must be fashioned very carefully so as to fit the irregular configuration of the dinosaur bones and at the same time detract as little as possible from the skeleton itself. Mounting a large dinosaur skeleton in this fashion may require the complete efforts of one or two men for periods of two, three or even more years. If, as is usually the case the specimen is not completely represented, since part of the animal's skeleton may have been carried away before the carcass was buried and part of it may have been destroyed by erosion before the skeleton was discovered by the paleontologist, some missing parts of the skeleton may have to be reconstructed in plaster of paris. This is a quite legitimate solution to the problem because otherwise, even though the scientist may have a good idea of what the complete structure of the animal looked like, the laymen may not be able to understand the structure of the animal if, for example, the skeleton was mounted with only three legs and only the back half of the tail with nothing in between it and the rest of the body. So these missing parts are frequently reproduced in plaster using either bones from the opposite side of the same skeleton as a guide, or else using bones from skeletons of other individuals of the same or very closely related

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species. In this way the public is assured of the accuracy of the reconstruction, and need not fall prey to the sometimes heard exclamation in museums, "After all they make these things out of plaster." This is not the case!

WHAT KILLED THE DINOSAURS?

It is impossible to state definitely what caused the extermination of the dinosaurs. It is also impossible to state whether a single factor was operative or a combination of many.

Perhaps the most general explanation would be that these great animals were unable to adapt themselves to changing conditions. They may have succumbed to other more progressive animals. They were cold blooded, sluggish, with a small and lowly organized brain in comparison to their bulk, which may have made it difficult for them to compete with more efficient warm blooded mammals which appeared at the end of the Cretaceous period. Small mammals could also have preyed upon their eggs.

There may have been other changing conditions in their environment such as a sudden climatic change, perhaps a flood, perhaps a suffocating blizzard of volcanic ash and gas. A change in food supply may have been an important factor and food supply change may have been brought about to some extent by alteration in climate which also could have affected the dinosaurs, but probably affected the type of vegetation. Perhaps the draining of the lowlands was another factor. The great problem in explaining the extinction of any group of animals lays in the fact that an explanation that would account for the extinction of any one animal or one small association of animals may not be sufficient to account for the extinction of the really great variety of features which actually occurred. There is no really good explanation of extinction that would account for the disappearance of the dinosaurs on land, the flying reptiles in the air and the marine reptiles in the water.

It is believed that a race or order can become old and weak in the same way as an individual. This is called racial senescence. This is often accompanied by overspecialization. During the closing years of the Cretaceous period the number of species and individuals gradually became fewer, although more highly specialized and gigantic. Large, specialized forms are easily exterminated if subjected to a change in habitat or food supply.

It should be borne in mind that these extinctions did not occur instantaneously or overnight, so to speak. They were long drawn out affairs which took probably millions of years to accomplish, that is speaking of the reptiles as a whole. Of course it was quite likely that local extinctions may have done away with all the dinosaurs in a specifically restricted area in a brief period of time.

If these animals' physiology was anything like that of the diving reptiles, just a simple hard freeze of two or three days duration would have been sufficient to kill them off. Certainly, too, a very brief period of exceeding heat would have accounted for the death of all the creatures that could not protect themselves from this heat, and this of course in the absence of water would have included practically all the dinosaurs, because after all it would be pretty hard for a dinosaur to crawl under a rock or dig a hole to get out of the direct rays of the sun, as modern reptiles and the little lizards in the deserts are able to do. As a matter of fact the lizards and snakes in desert areas (and this is where we customarily think of reptiles living today) are inclined to be nocturnal, coming out only in the cooler part of the day which is in early evening and in the early morning. In many instances the deserts are cold for them in the middle of the night and they again retreat under the rocks, where there is a degree of warmth. During the middle of the day when the sun beats down on the desert, no reptile can withstand this high temperature for very long. They lose control of their muscles, are unable to get out of the rays of the sun and simply lay down and "stew in their own juice."

Thus we may speculate along various interesting lines of thought. But with certainty we may say the day of the dinosaur was over as the Cretaceous period drew to a close, and the future so far as reptiles were concerned was to belong to the relatively small animals that we know today, the lizards, snakes, turtles and crocodiles.

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OUR LITTLE CHURCH

By BILL DOWSON

All of us, no matter what our religious beliefs or church affiliation, find that expressing ourselves to God is sometimes a difficult task. We pray in our churches or in the out of doors. We teach Sunday School or pick flowers from the garden for the church pulpit. We sing in the church choir or we spend a little time each day reflecting on the things the Lord created for us on our planet. Or we make a child smile or visit a sick friend. In these ways and the many others in which we express our gratitude to God, we are in actuality thanking him for the gift of life and the living of it.

The little church in our valley was built by men who, through their own skill and imagination, were expressing their thanks to God.

The sign painter laid aside his coarse brushes and tracing paper to take in his hand the soft brush and the oil paints with which he transferred stories from the Bible to the glass of the church's windows.

The construction man laid down the blueprint and the level, and took into his hands, which have been toughened by years of working with concrete and steel; the hammer; and with his knowing touch helped to build the church. The men that helped him, drove the nails with a skill they could not have acquired in their jobs for they were clerks, shop-keepers and men of business.

The minister that helped in the building laid aside his coat and Bible to carry shingles and lumber, for he is a builder too.

And when the bell was hung in the steeple and the little church gleamed brightly finished in the sun, these men, each of them, knew that he had not just helped build a church, but had assisted in erecting a tribute to the Almighty.

Not one man said this to another, but each one knew. For we all express ourselves in different ways to God and men don't discuss these things aloud.

So our little church, which seats 100,000 six at a time, is more than a pretty landmark, more than a tourist attraction. It is an expression of thankfulness for that is the kind of men these are.



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BISON OCCIDENTALIS

A new and important addition to the exhibits of the Drumheller Fossil Museum in 1966 is a large portion of the skeleton of an Ice Age bison known scientifically as *Bison (Bison) occidentalis* Lukas. This skeleton is on permanent loan from the Research Council of Alberta. It was excavated in 1957 by two geologists from the Research Council of Alberta: Dr. L. A. Bayrock and J. F. Jones.

These bison remains were found in an outcrop on the south bank of the Oldman River near the town of Taber, Alberta. All the bones were embedded in fine alluvial (deposited by running water) sand. Most of the skeleton was found in articulation except for some of the leg bones which were somewhat disjointed. The bones were deposited in an oxbow lake of the ancestral Oldman River. Carbon 14 dating of wood found in association with the bones places the age of this fossil skeleton as between 10,500 and 11,000 years.

Bison occidentalis migrated southward from Alaska along the receding western edge of the Ice Age glacier of Wisconsin time during the Pleistocene epoch. Only one glaciation is believed to have occurred in Alberta. The plains bison or buffalo is an evolutionary descendant of the extinct *Bison Occidentalis*.

Within the skull of this specimen was found a somewhat rounded boulder, the significance of which is described below.

THE EARLIEST KNOWN EVIDENCE FOR MAN IN ALBERTA

The stone artifact displayed with the skeleton of *Bison occidentalis* was originally found embedded in the brain case of this bison. This the excavators kept out of curiosity, because it was inconceivable how such a boulder could have been deposited together with the surrounding medium-grained sand. Later inspection of the boulder by R. S. Forbis and A. L. Bryan, archaeologists, University of Alberta, revealed that the boulder is an artifact—a pebble chopper.

The cobble shows evidence of use by battering on all edges and on one face. No doubt the pointed ends would be very effective for crushing a skull. As it was found in the brain cavity, where it could not have been deposited by natural processes, it is certainly a human artifact, and represents the earliest known evidence for man in Alberta.

Abundant evidence is now available to indicate that essentially all of Alberta was glaciated during late Wisconsin time. As all of British Columbia and the remainder of the prairie provinces were apparently also glaciated until 10-12,000 years ago, the conclusion must be drawn that man must have moved south of Canada sometime prior to the late Wisconsin ice advance.

Evidence has accumulated in recent years to indicate that most of central and south-central Alberta was glaciated only once. This glacier emanated from the northeast as an extension of Keewatin ice, as shown by erratics derived from the Canadian Shield. At present the only evidence pertaining to the time of glacial advance is a radiocarbon date of more than 31,000 years. The Taber date is the only evidence now available for dating the end of the glaciation.

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DRUMHELLER AND DISTRICT MUSEUM SOCIETY

1967

The Museum serves the following functions:

1. In co-operation with the Alberta Tourist Association it is the centre for tourist information for the Drumheller area.
2. The Museum displays are designed to interpret the geology and palaeontology of the unique Drumheller area.
IT IS STRONGLY RECOMMENDED THAT ALL VISITORS VISIT THE MUSEUM BEFORE TOURING THE DINOSAUR TRAIL AND OTHER POINTS IN THE AREA. By so doing they will enjoy their visit to the full.
3. The Museum provides facilities for the display, preservation and protection of materials that might otherwise be lost.

Our major exhibits include:

Mounted skeleton of the Duck-bill
Dinosaur *Edmontosaurus*
Skeleton of *Bison occidentalis*
Geology of the Badlands
The Inland Sea
The Petrified Forest
Coal
Fossil Collection of Wm. R. Fulton
What Are Fossils?
Juniper Carvings of
W. G. Hodgson

Chart of the Geology of
the Badlands
Dinosaurs (Classified)
Dinosaur Hunters
Duck-Billed Dinosaurs
Horned Dinosaurs
Carnivorous Dinosaurs
Miscellaneous Dinosaurs
Mammals
The Ice Age
Indian Artifacts

Early Photographs of Drumheller

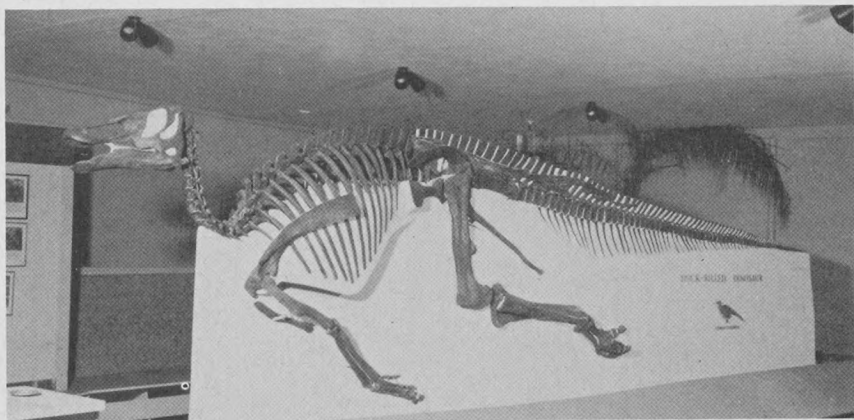
Pachyrhinosaurus

Ichnite Foot Print

The reach of a museum can be measured in terms of the number of visitors multiplied by the range and number of effective visits they study. The use of this educational resource grows each year as evidenced by increasing school class groups, tourists and casual seekers for knowledge. Visitors in 1966 totalled over 63,000. In addition, the mail and other requests show an increase each year.

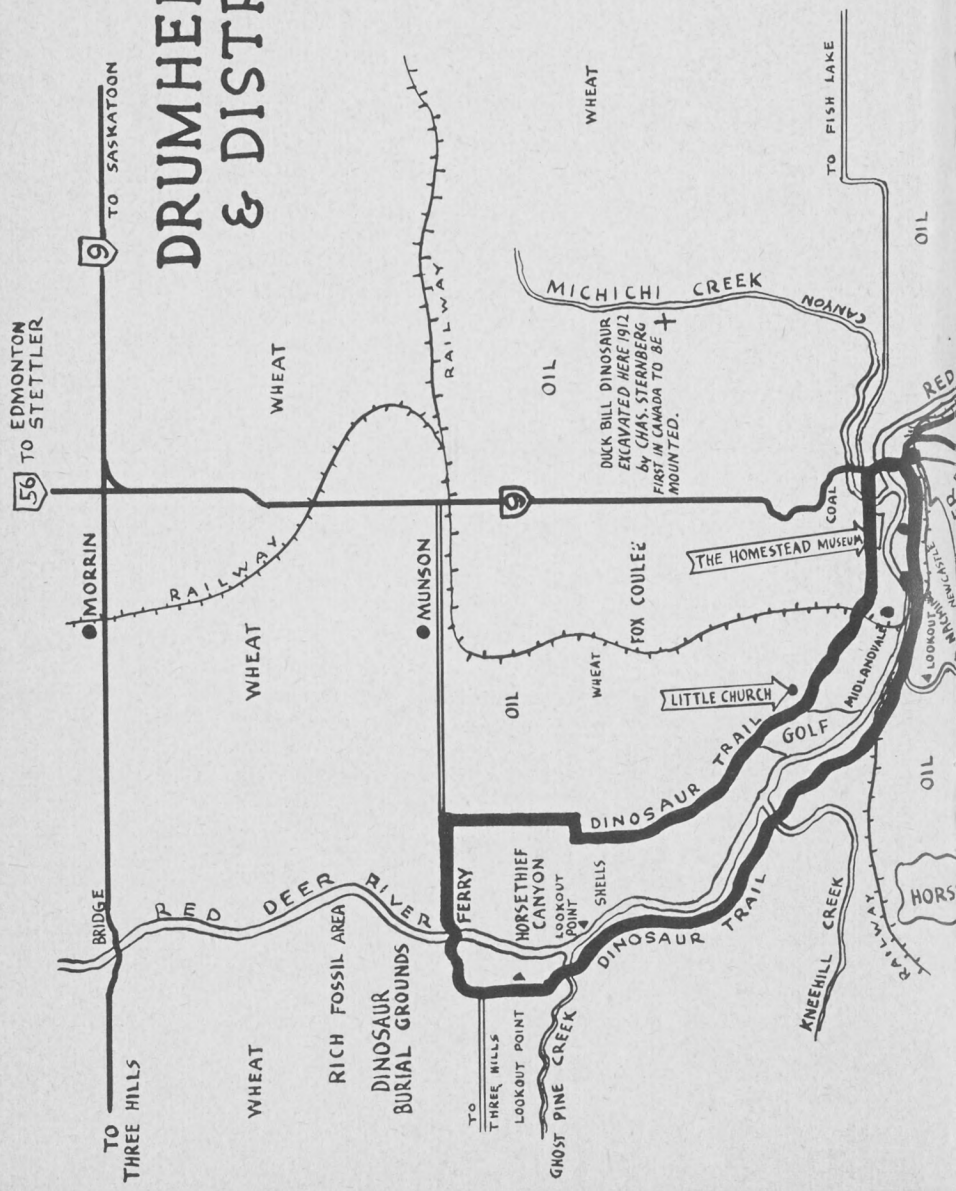
The Museum is constantly striving to improve, enlarge and revise its exhibits. Financially, the improvements in our facilities depend entirely upon the donations of our visitors.

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Mounted Duck-billed Dinosaur, Drumheller Museum

DRUMHELLER & DISTRICT



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Alberta has five national parks within its borders — Banff, Jasper, Waterton Lakes, Elk Island and Wood Buffalo. The last named, Wood Buffalo, is in the far northeast of the province and is purely a game reserve and has no facilities for tourists. The parks of Banff, Jasper and Waterton Lakes are really Canada's mountain playground. The spectacular scenery, abundant recreational facilities and modern accommodation (everything from luxurious resort hotels to campgrounds, trailer parks and guest ranches) please every visitor. While Elk Island National Park, ideally situated a short distance from Edmonton, does not have the mountains or the size of the other three holiday resorts, it is a delightful vacation area and is a reserve for the buffalo which, in days gone by, wandered over the plains at will.

The Columbia Icefield Highway, between Banff and Jasper, is frequently called one of the world's most spectacular routes by International travellers. The highlight of the trip is a ride over the eons-old Athabasca Glacier in a snowmobile. The magnificent solid ice of the field stretches for miles in every direction, giving a small idea of what the northern part of the continent must have looked like during the ice age.

Both Banff and Jasper national parks in Alberta have hot mineral springs, bubbling through the rocks, which are used for their therapeutic qualities as well as bathing.

The Red Deer River Valley cuts through south-central Alberta. The eastern portion of the valley particularly between Three Hills and Brooks holds many secrets of the ancient past. The valley walls yield up specimens which delight the palaeontologists. The museum at Drumheller, with its collection of bones, fossils and huge reconstructed Edmontosaurus duck billed dinosaur is a fascinating place to visit.

Fishing is a twelve-month-a-year sport in Alberta. The cold mountain streams give trout that extra zip both in energy and taste most appreciated by fishermen. Perch, pike, pickerel (walleye) and Rocky Mountain whitefish are equally delicious. Waterfowl and upland bird hunting is a great sport in the fall, and big game hunting is enjoyable and rewarding.

These are but a few of the pleasures of visiting Alberta. We have many others, such as the Calgary Exhibition and Stampede (the greatest outdoor show on earth), the Horseman's Hall of Fame, the famous zoo in Calgary, and their Happy Valley; Klondike Days, Muk-Luk Mardi Gras, the planetarium, the Children's Storyland Valley Zoo and the River Boat Rides at Edmonton, with the Alberta Game Farm and the Northwest Pioneer Village just on the outskirts of the city; the wonderful identical auditoriums in Calgary and Edmonton; the only paved highway corridor to the Alaska Highway — they are too numerous to mention. Come and see for yourself.

We have special events for each season of the year. Edmonton's Muk-Luk Mardi-Gras, held annually in February, is fast becoming one of the most popular of Canada's winter carnivals. There are competitions for Queen (the winner is crowned at the Muk-Luk Snow Ball, a masked formal dance), Native Events, power toboggan runs, dog sled races, skidoo races, moose calling, ice carving, as well as many other participator and spectator events.

For summer visitors there is an exciting series of rodeos and stampedes, the biggest of which is, of course, the Calgary Exhibition and Stampede. This fun-filled week, always the first full week after the fourth of July — is world famous for its cowboy displays of roping, riding and bucking. The chuckwagon races, originated at Calgary in the early days, is, perhaps the most thrilling for both riders and viewers. Citizens and tourists alike join in the spirit of

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the show by wearing western dress. The Calgary Exhibition and Stampede is always a huge success.

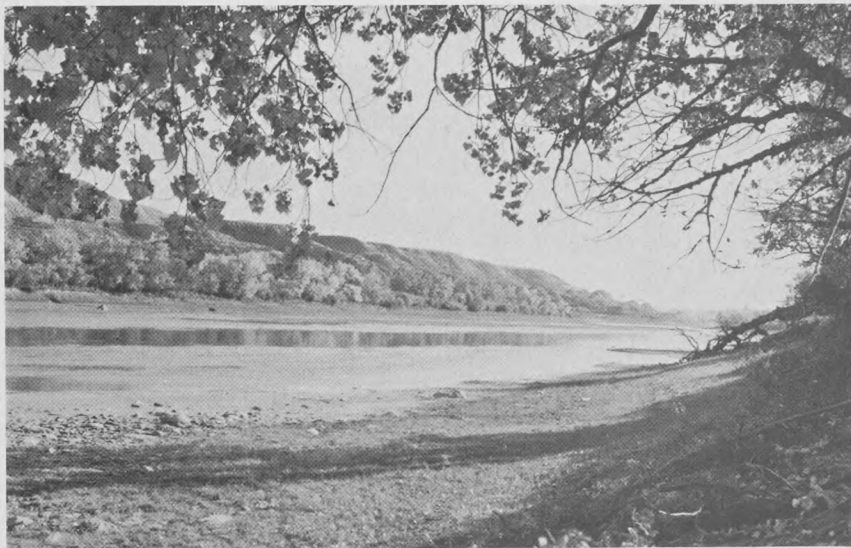
Klondike Days, in Edmonton, are celebrated during the week immediately following the Calgary Stampede. This has become quite an exciting and enjoyable six days, when Edmontonians, many in the dress of the turn of the century, play hosts to thousands of visitors. Although a comparatively new theme, the idea has sparked the imagination of city residents and visitors. Each year new events are added to the thrill and glamour of mining for "honest-to-goodness" gold, listening to music by Klondike Kate, riding the paddle steamer down the river — you will enjoy every minute of the show.

For those who like the "native touch" Banff Indian Days is an exceptionally fine festival. For four days the Stoney Indians parade, dance and display native folklore, at Banff, Alberta. No place else in Canada boasts of an Indian tribe which turns out annually for the sole purpose of entertaining its white brothers!

Jasper National Park is beautiful in September, and the Totem Golf Tournament, held over the Labour Day Weekend, attracts many spectators. Even if you are not taking part in the tournament it is sheer pleasure to walk over the Jasper Park Lodge Golf Course. Each tee is lined up with a spectacular mountain peak, and the greens are velvet-smooth. Autumn in the Canadian Rockies is something special.

For other sports-minded folk we have baseball games, football matches, swimming competitions, etc., and during the winter every known sport is available including skiing, snowshoeing, tobogganing, skating, curling, hockey, etc., in fabulous surroundings, proving that in Alberta, winter is a pleasure — and every season is holiday time.

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BENEATH THE DINOSAURS FEET

Excerpts from a lecture at the Drumheller Fossil Museum, August 1, 1965

By DR. WILLIAM CLEMENS
University of Kansas

In the course of a Paleontological Field Trip in 1963, sponsored by the University of Alberta and with participants from all parts of the world small mammal bones were discovered quite by chance near Tolman Ferry on the Red Deer River. As the result of this discovery joint field parties representing the University of Kansas and the University of Alberta spent the summers of 1964 and 1965 in the Tolman Ferry area and plan to return again in 1966.

It is well known that the dinosaurs, the large cold blooded reptiles were abundant along the western shore of the great inland sea which extended from the Arctic Ocean to the Gulf of Mexico. It is not so well known that in the period of sixty to seventy million years ago, which the Edmonton Formation represents, that there were warm blooded animals present in this area, the mammals. Mammal bones of the same age have also been found in Montana, Wyoming and New Mexico.

The earlier paleontologists who explored for and collected large vertebrate fossils in this area were primarily interested in dinosaurs and did not see the smaller bones of various types of small warm blooded animals that were the contemporaries of the dinosaurs. We are interested in what kinds of mammals existed contemporaneously among the 'terrible lizards'.

Exploring an area searching for the remains of these small early mammals is a laborious process of climbing up and down coulee banks, often crawling or bent over looking for very small fossils. Some of the indices that we have of the presence of mammals are small fossil scales of a fish related to our modern gar. When a concentration of these small fossils is found we process the matrix (sand and shale) by a special technique. The rock stratum containing these small fossils is dug out and loaded into sacks. Each burlap sack containing about fifty pounds of rock is transported to the river and emptied into a box with a wire screen bottom. The boxes are dropped into the river and we allow the river waters to dissolve and break up the sediment. The sand and clay washes out leaving a residue of small pebbles and bones. These are dried and sorted. The technique is quite different from that of excavating large dinosaur bones and surrounding them with plaster casts. I think that we are finding mammals and other small vertebrate fossils where they were not found before, just because we are looking for them in a special way.

Let us review the scene in which these small mammals lived. The dominant vertebrates were the dinosaurs which became extinct sixty-three million years ago. There were hadrosaurs, horned dinosaurs, armoured dinosaurs, bird-mimic dinosaurs and huge carnivorous dinosaurs.

Our evidence indicates a tropical climate like Florida or the Gulf of Mexico today. This was a climate in which a year could pass without frost. There were dense forests and perhaps savannas, plenty of lush vegetation for the large herbivorous dinosaurs to feed upon.

In the streams of Alberta of that day a fisherman would be up against different problems than at present. Apparently one of the most abundant fish in the region was a fish related to the alligator gar, now known in the Mississippi Delta region and along the Gulf Coast. We have evidence of small fresh water sharks. Quite abundant are the teeth of an animal that looked like a skate or ray. This creature we believe had a very flattened body and came equipped with a series of small polygonal teeth which were grouped together in the jaw giving two great massive plates. These could be used to crush shell fish to get the body of the animal inside. In addition we found remains of perch-like fish and fish related to modern bull fins.

There were a number of amphibians and no doubt frogs were croaking too. There was an abundance of salamanders, very similar in type to those we find in tropical and sub tropical forests today. In addition there were turtles, true crocodiles and crocodile-like animals, the champsosaurs. Lizards were present and abundant. Some of the early records of snakes come from beds of this age. The snakes were just beginning to appear.

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If you had been in Drumheller sixty-five million years ago, what types of animal were flying? First of all there were reptiles that developed elongated forelimbs on which were stretched great membranes. These animals in sort of bat-like fashion were able to fly. These are the pteradactyls. In addition we have evidence from Montana, but not Alberta that there were primitive birds present. There were flamingos and a variety of shore birds.

Now I have talked around the group of animals that are the focal point of my interest. These are the mammals; animals with back bones, warm blooded, suckling their young; animals which are covered with fur. These were present and have been present on the earth's surface for almost a hundred million years, long before the deposition of the Edmonton formation. For some reason, although mammals were present for a very long time, they did not assume an important role in the environment of sixty million years ago.

You may characterize the animals of that day as being small, not being of too many kinds, but being rather widespread in their range. The mammalian remains that we have been able to discover here in Alberta, and also in Montana and Wyoming indicate that the mammals of that time can be broken down into five groups. There were no squirrels or gophers at that time. Their place was filled by another group of mammals called MULTITUBERCULATES. In restoration they look like modern mice and rats. Apparently this group was an evolutionary experiment that existed for a while and then became extinct, its place to be taken by the true rodents of today.

In the faunas of that time were animals related to the modern American opossum. These are representatives of the group of animals we call MARSUPIALS. These are animals in which the young are born in a very rudimentary condition and migrate into a pouch where they continue their growth for a period of several weeks or months. Marsupials in some abundance were present in this fauna associated with the large dinosaurs.

Also present were small animals we call INSECTIVORES because they reflect the habit of the living kinds of insectivores, which are animals that make their diet primarily of various types of insects. The hedgehogs found in Europe today are insectivores, but we have none here. The insectivores living in North America today are classed in two groups; true moles and a very small insectivore, the shrew. The hedgehogs, moles and shrews are just surviving relics of the most primitive group of non-marsupial mammals. They are the relics of that stock then, from which all the mammals other than marsupials took their origin.

There is another animal living today in Malaysia and Indonesia about which there is an argument among specialists. This is the so-called lesser tree shrew. The argument centres around whether it is a primate or an insectivore. It exhibits many traits of both. TREE SHREW-LIKE ANIMALS have been found in beds deposited sixty million years ago or older. This suggests then that a line of evolution leading toward the higher primates, monkeys, apes and man became split off and differentiated as early as sixty or seventy million years ago.

Another group of mammals that was becoming discrete at the time the hadrosaurian dinosaurs were moving around this area was the CARNIVOROUS MAMMAL GROUP. Primitive representatives of this flesh eating group, but still definitely carnivorous were present at the time the Upper Edmonton formation was being deposited. Of this group today we have cats, dogs, bears, raccoons, weasels, skunks, etc.

A very valid question to pose is "Why are you spending your time and energy out on the banks of this valley trying to collect the remains of these organisms?" This question could be answered from several viewpoints. First of all I would argue very sincerely that any gap in our knowledge is a challenge and it is a valid exercise to spend your time trying to fill in our knowledge of some phase of the universe in which we live. To the specialists in paleontology, the rocks of your Upper Edmonton formation and other rocks deposited sixty to seventy million years ago are quite critical. At this time after a hundred million years of existence the mammalian groups were beginning to evolve and differentiate. For the first time you could say "these are primates" and "these are carnivorous", and "here is a stock which is ancestral to hoofed animals such as sheep, goats, and horses".

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Another biological phenomenon that merits a good deal of study and interest is the extinction of the dinosaurs. Why should reptiles so abundant and diverse become extinct at all? This extinction was a phenomenon that occurred not only in Alberta, but all over the world at about the same time. Many types of shell fish and other invertebrates became extinct at just about the same time. Some groups of mammals survived the extinction of the dinosaurs and went on in later times to evolve into the various forms we know today. Other groups of mammals suffered the same fate as the dinosaurs. Some groups of shell fish became extinct while others did not. We have what seems to have been a random selection of groups that became extinct. There must be some reason behind it. Perhaps a study of the different types that were present with these dinosaurs and immediately after their extinction and interpretations of environment and climate will shed some light on the reason for this major extinction. The extinction of the dinosaurs was not the only major extinction that occurred in earth's history. There have been other times, both before and after, when major groups, when large numbers of major organisms have become extinct about the same time. What causes these great periods of dying? It's still an open question, but an important question, particularly when you consider how much we are doing with our human cultures to modify the environment of the world today.

DINOSAUR FOOTPRINT FOUND

The Drumheller Dinosaur Museum is in possession of a dinosaur footprint, a description of which is very interesting and made by Dr. Dale Russell, Curator of Fossil Vertebrates of the National Museum of Canada, Ottawa, as follows:

"The footprint Allan Jensen and his father collected is very interesting from a number of viewpoints. First of all it seems to be a hadrosaur, which is significant, for hadrosaur footprints for some reason are very infrequently found. Secondly, it is very large, being about one third again as large as hadrosaur footprint described by Dr. Langston, which was from the St. Mary River Formation. Thirdly, if it was found at Willow Creek it comes from a horizon very low in the Edmonton Formation and therefore from a generally brackish water facies.

"I think because (a) the footprint is very large and Edmontosaurus specimens are frequently very large hadrosaurs, and (b) because Edmontosaurus is the only hadrosaur to occur in the lower portion of the Edmonton Formation, we can reasonably assume the track was made by this dinosaur.

"Now an unusual thing about its occurrence is that it is so low in the formation. I have made a geologic section of the strata as they outcrop at Willow Creek and would be grateful if Allan Jensen or someone would indicate approximately where in the section or how high above the river the specimen was. I assume it was from the breaks along the north bank of the Red Deer.

"Articulated dinosaurian remains do not begin to occur until much higher in the formation at about the level of No. 7 coal seam. If the weather holds it might be fun if someone went out and tried to find the trackway this print came from. If it could be found it would be very important as hadrosaur trackways have never been described. Trackway evidence would certainly settle the question. In short, you have another very fine specimen. It surely is nice that you can be "on the spot" when news of these discoveries come in. If I can ever be of help or give the museum moral support in my official capacity please let me know right away."

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DRUMHELLER COAL FIELD – 1793-1967

By SIDNEY G. McMULLEN

The earliest recorded discovery of coal in the Drumheller area was related by Peter Fidler in 1793 when he reported coal near the junction of the Rosebud and the Red Deer rivers.

Some two hundred years later, in 1911, the first mine was started in the Valley and the Drumheller coal industry was born. Prior to this, early settlers had scratched their coal requirements from the outcroppings of the seams along the Valley walls. Coal mining expanded in the Valley when the present C.N.R. railway reached Drumheller from the north in 1912. With the completion of the C.N. line to Calgary in 1914, production increased rapidly and grew to over a million tons annually by the year 1920. At the end of the roaring twenties production had reached a million and a half tons annually, with over 2,000 men directly employed in the mines. Peak annual production was reached in 1947, when just under two million tons of coal were mined. During the period 1911 to 1966, over 59,000,000 tons of coal were produced in the Drumheller area.

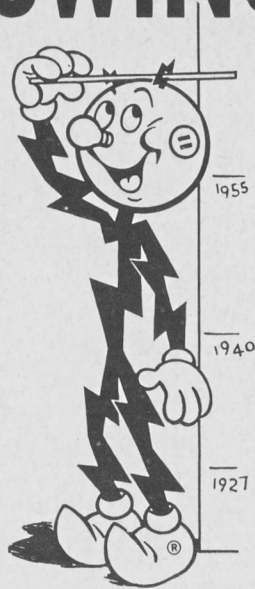
Drumheller coal is classed as Sub-Bituminous B, but is better known as "The best domestic coal in the west." The sized coals are clean, shiny and blocky, low in ash, soot and smoke, with high heat value and make the ideal coals for household use. The fines are used in power houses to produce steam and electricity. Drumheller coal is sold from Quebec in the east to Vancouver Island in the west.

The discovery of untold gas and oil fields in Alberta and the other western provinces since the late 1940's, has had a very adverse effect on the Drumheller coal industry. These competitive fuels, plus lower quality strip coals, propane and electricity, have rapidly eaten into the established markets, and today the Drumheller field produces only a quarter of a million tons of coal annually, giving employment to roughly 125 men.

Since 1911 many mines, large and small have come and gone in the Valley. One can still see foundations and other indications of their existence throughout the Valley. The early mines used manpower with picks and shovels, black powder, and ponies to produce coal. As the years rolled on, mechanical mining equipment became available and was introduced into the mines. The coal mine is a mechanized wonderland. A trip, on paper, down the Charter Coals Ltd. mine in East Coulee will show this advancement.

Since fire is an extreme hazard in coal mines, all smoking material is left on the surface, and all electrical equipment used in the mine must be explosion proof. After being supplied with a hard hat and an electric mine lamp, one enters the cage to be lowered 400 feet to the coal seam at the shaft bottom. The seam around 10 feet thick, is practically horizontal, and coal forms the roof and walls of the tunnels or entries. At the shaft bottom, a train of empty five-ton mine cars, pulled by an electric locomotive is boarded and one is transported to the working faces, a considerable distance from the shaft bottom. The temperature is around 55 degrees all year round. Fresh air is pumped continually throughout the mine by large fans on the surface. One will notice timbers along roadway supporting the roof and other tunnels and doors branching off from the main haulage road. At the working face, on leaving the train, one will go either into an entry face or a room and watch a coal loading cycle. Firstly, men will be seen operating a huge machine called a coal cutting machine that works on the same principle as a chain saw. It is advanced to the face and starts to cut into the coal at the floor. This machine makes a cut 5" to 6" in height and 9 feet deep into the coal, right along the face. The cutter head of this machine can be rotated, raised or lowered. The men will cut the coal at the roof, in the middle of the seam or vertically, depending on conditions. With the cutting completed, the machine is withdrawn and the coal is blasted down by a fireboss using compressed air, at pressures up to 10,000 lbs. per square inch. This air replaces the old Black Powder and other permissible explosives. A special air cylinder is placed into holes drilled in the coal face, and when the pressure is released, the coal shatters into workable sized pieces. After shooting, a loading crew arrives with a large mobile loading machine. This machine has gathering arms at the front which as the machine is advanced, picks up the pieces of coal and puts them onto a conveyor running the length of the machine. This conveyor takes the coal to the rear of the machine and loads it into waiting mine cars.

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On completion of loading the dislodged coal, the place is inspected, timbered, tracked, and the cycle starts all over again. The coal cars are then pulled out to the shaft bottom and are raised by the cage to start their five-mile trip to the tipples. The cars are made into trains and pulled by diesel locomotives over the company railroad. At the tipples the cars are dumped, oversized pieces broken up, and the coal is then moved along by conveyors, to the screening and cleaning areas where it is separated into various sizes and any impurities removed. From there it goes to the loading points and storage bins where men with mechanical boxcar loaders load the various sizes into railway cars for shipment to their ultimate destinations.

Space is too limited to describe all the hoist rooms, machine shops, cleaning plants, wash-houses, warehouses, offices, pumping stations, etc., that are used in conjunction with the foregoing operations. Needless to say, the organization and effort required to get a piece of coal out of the ground and into the railway car is enormous. It is well worth it though when one considers the warmth, comfort and satisfaction this piece of Drumheller coal will give to the ultimate consumer. When burning it, one should remember that the energy in this coal was created by the rank vegetation that grew on this earth millions of years ago, and, that is another long story.

HOODOOS

The rock layers exposed in the Red Deer valley walls are composed of different materials such as sandstone, shale, clay, ironstone and coal. Since these rocks differ greatly in hardness some of them resist erosion better than others. The harder rocks are usually thinner than the softer ones in this particular region. When the hard layers are undermined by the erosional activity of wind, running water, freezing, thawing and so on, the harder layers tend to remain as protection for the softer rocks below. As erosion progresses however, the softer rocks and then the protective harder tops become separated from the adjacent rock masses and this often results in a series of gigantic "toadstool" structures that have been termed hoodoos. Hoodoos are a characteristic feature of badlands everywhere and may vary in size from tiny structures a fraction of an inch in height to massive pillars as tall as buildings. Some good examples of hoodoos can be seen at Willow Creek where resistant sandstone layers at the base of the Edmonton formation cap pillars of softer and more easily eroded shale of the Bearpaw formation.



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TOURISTS GOING EAST

By KERRY WOOD

The main holiday travel routes of Albertans are westward to the Rockies, either at Jasper or Banff, beyond Rogers Pass to the coast or southwest through The Windermere Valley into the United States. Not too many Albertans realize what a wonderful pleasant pleasure land is awaiting to the east.

"Prairies?" asks you.

"Badlands," sez I.

Not many miles north and east of Calgary are the world famous Red Deer Badlands, centered by Drumheller but extending up and down the river for two hundred miles from the Content Bridge down to Dead Lodge Canyon beyond Stezeville. A hundred million years ago this was a sub-tropical region where redwoods, ginkos, and cypress trees grew, also giant rushes which eventually formed coal beds almost deserted today. In that steamy marshland of tropics, the dinosaurs thrived. Over fifty varieties ranging from the small bird-mimic dinosaurs that looked like primitive ostriches up to the killer carnivore known as Tyrannosaurus Rex.

If you want to see reproductions of dinosaurs, you need only go to the Calgary Zoo on St. George's Island. The reproductions originated by John Kanerva are marvelous, but it is also pretty wonderful that the small city of Drumheller, unable to afford the services of Mr. Kanerva to provide them with a dinosaur of their very own, made use of that old-fashioned commodity known as resourcefulness. Local workmen combined their skills to reproduce a tyrant dinosaur near the traffic bridge at Drumheller. This home-made model is better suited to the town, because Drumheller welcomes visitors. And by some happy talent, the home-town boys gave their Tyrannosaurus Rex a kindly expression, implying that it would never, never do any harm to a tourist!

You could spend a month in the Drumheller district and never lack for items of interest to see, especially if you had any desire to collect rocks, petrified wood, and dinosaur fragments. Don't forget the little museum right in town, with a duckbilled dinosaur skeleton the main drawing card. Huge stumps of petrified wood are outside the museum door, while display cases have a pleasant variety of exhibits ranging from Indian artifacts to Bill Hodgson's unique juniper root carvings which are world famous in their own right.



Visit the swinging bridge at Rosedale. Once this suspension bridge was the main avenue across the Red Deer for miners working at the old Star. Go to the banks of the Rosebud creek nearby. There in 1793, Peter Fidler found coal. Early explorers must have seen plenty of coal on the western river banks, yet Fidler was only the second to report its presence, Alexander Mackenzie beating Fidler's report by three years. Fidler made an interesting observation during this trip: Indians with more than one wife found that it contributed to domestic bliss to house each wife in a separate teepee! On the same creek bank, in 1885, Dr. J. B. Tyrrell was the first to report the presence of dinosaur remains, the big thrill of his 99 year life.

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Wayne is a ghost town only ten minutes' drive from Drumheller. Once a thousand miners worked there, less than fifty persons live there today. Talk to Mrs. Wong at the little general store and hear her first-hand account of the death of the town. Wayne came into being in 1914; prior to that, it bore the peculiar name of Rosedeer.

There are the ferries to ride and the beautiful Wintering Hills south of East Coulee to remind you that Jimmy Jock Bird, interpreter for Treaty 7 at Blackfoot Crossing on the Bow in 1877, had a horse ranch there. So did Sam Drumheller years later, and in 1911 Sam and others interested in the coal fields set up the town site of Drumheller.

Visit the lovely Hand Hills and Fish Lake, then travel eastward onto the prairies beyond Hanna where farmsteads are far apart and neighbors are friendly. Leave the blacktop and go south to the river again, to Buffalo and to the estuary near Empress, coming back to the bald Rainy Hills where Chiefs Crowfoot and Sitting Bull once met and decided not to form a Blackfoot-Sioux alliance against the whites.

Or go upstream to Rumsey's Big Stonepile, which is the most important Indian monument on the whole river. You'll find many godstones marked with strange symbols, once revered by old-time Indians. Keep going upriver to the suddenly famous Ardley bend of the stream, where Dr. James Hector of the Palliser Expedition found burning coal seams in 1859 and where Calgary, Red Deer and Edmonton may, in time, generate electrical power. Take your rod along, because goldeyes are biting and so are walleyes and pike. Birds are singing and wildflowers are in glorious bloom.

Try a different holiday route, eastward, for a change.

SKULL OF PACHYRHINOSAURUS

This article was written by Dr. Wann Langston, formerly Curator of Vertebrate Paleontology, National Museum of Canada, Ottawa. Dr. Langston is now with the Memorial Museum, Houston, Texas.

This is the skull of a large horned dinosaur or ceratopsian. A great variety of such animals existed in North America during the closing epoch of the AGE OF DINOSAURS some 75 million years ago. The best known ceratopsian dinosaur was the spectacular TRICERATOPS whose remains are common in Wyoming and some other states, but are also found in Saskatchewan and in the Drumheller Valley. PACHYRHINOSAURUS is among the least known members of the group. Pachyrhinosaurus was unique because in place of the usual great horns of most ceratopsians the top of its head was tremendously thickened to form what is best described as a battering ram. In life this was probably covered with a thick, tough hide, and may have been used in combat, or as a means of pushing over trees while feeding. The living animal was perhaps 20 feet long and weighed as much as two large elephants (10 to 12 tons). It walked on all-fours with the huge head carried close to the ground. Pachyrhinosaurus was a ponderous vegetarian. Its powerful jaws carried many small teeth, which are not seen in the specimen, and at the front of the mouth there was a turtle-like beak.

As usual with fossil specimens some of the skull had been lost by weathering before it was discovered. Where sufficient information was recovered the missing parts were restored in plaster of Paris to give a better idea of the appearance of the skull. However, the back of the specimen was badly damaged and much of it was missing. This part in the other known skulls is also missing and there was no way to determine just how it looked. Therefore there was no attempt made to reconstruct the back of the skull.

Pachyrhinosaurus bones were first discovered in Southern Alberta, and until this specimen was found in 1960 no trace of it had been seen elsewhere. This is the best example yet found and it has provided much new information to the science of paleontology. It was discovered in the rocks of the Edmonton Formation on the Red Deer River, near the Munson Ferry. It has been the subject of a technical report, "The thick-headed dinosaur Pachyrhinosaurus (Reptilia Ornithischia), from the Edmonton Formation, near Drumheller, Alberta, Canada, by Dr. Wann Langston, Jr."

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A TOUR OF THE DINOSAUR VALLEY

By MARION SMITH

Rolling and rolling, away, away . . .

A hundred hills and canyons

Blue shadowed, brown and gray . . .

Do you like to get off the beaten path on your holidays? Somewhere quiet? Somewhere so weirdly beautiful that man in all his efforts cannot add to nor subtract from its splendor? Are you interested in Natural History? Or lapidary work, or painting, or photography? Do you enjoy rugged western scenery, equalled only in the American southwest? Then come to Drumheller during Centennial Year and see Alberta's Grand Canyon!

Your first stop should be the Dinosaur Museum located in the downtown area on First Street East. This is also your tourist information centre. Thousands visit this Museum each year and are amazed at seeing the many prehistoric exhibits as well as proof that many skeletons of dinosaur were unearthed here, in the hills of the Red Deer Valley.

The Dinosaur Trail is a sightseeing tour that takes you from the Tyrannosaurus Rex (dinosaur model) at the bridge, across the river, two blocks, where the road turns west. From here on follow your nose westward. Be sure to see the Homestead Museum, with its antique tractors, cars, and household equipment. Well worth a visit! Some miles farther on you will find the Little Church, picturesque in its Badlands setting. The Golf & Country Club is on the opposite side of the road in this area. The road continues on up the hill to the viewpoint atop Horsethief Canyon. Nearby are the Oyster Beds which prove this area to have been once inundated by a great inland sea, long after the demise of the Dinosaurs.

Your trip will show you the Drumheller Oilfields and the fine wheat growing district of Munson.

Reaching the main road turn west toward the valley and down to the Munson Ferry, which will take your car across the river at a leisurely pace, to the Dinosaur Graveyard beyond. Here you may see where a complete Dinosaur skeleton was excavated from its resting place of millions of years, and sent away to the National Museum at Ottawa. You may want to hike back into the hills and explore this area for yourself.

Continuing the second half of the tour will take you up out of the Valley into the Orkney district, another fine livestock and wheat country. The road will soon descend once more into the Valley with views of breathtaking beauty. The road now leads back through urban areas to Drumheller.

See the Swinging Bridge at Aerial, as you take Highway 10A eastward from Drumheller. Farther along this road are the famous Hoodoos, which you really must see!

Drumheller is in the midst of a tremendous building and expansion program. Some recent additions being the new Federal Young Offenders Penitentiary atop the Twin Hills east of Highway 9. The newly constructed Drumheller Arena is the home of the Drumheller Miners Hockey Team, Allan Cup Champions of Canada.

Hotels, Motels and Campgrounds

There are three motels and several hotels all offering clean, modern accommodation. The City Campgrounds are located behind the Arena near the river; with toilets, showers, etc.

Government Campgrounds

Located west of the bridge in North Drumheller, in a sheltered area beside the river. There are three other Campsites along the Dinosaur Trail: one opposite the Hoodoos, on the road to East Coulee; one at Newcastle Beach, where you may also go for a swim; and one at Munson Ferry at the far end of the trip around the Valley.

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Drumheller and District Chamber of Commerce

By A. O. BRAY, Chairman, Tourist Committee

The Drumheller Chamber has over the past 12 years been most actively interested in the promotion of tourism in the Valley. Of just as great a concern has been to ensure that persons visiting our "Badlands" enjoy themselves and wish to come again. To this end the Tourist Committee tries to work very closely with all other organizations and business concerns which make up Drumheller's tourist attractions and facilities.

From funds made available by the Chamber and the City of Drumheller many thousands of brochures, describing this very unique area, are distributed each year throughout Canada and the United States. While no picture nor description can possibly do justice to the unusual sights and quite magnificent views that await the newcomers to our Valley it is hoped that they will give some indication as to what is offered. From the comments of the nearly 70,000 registered tourists who visited here during 1966 there is no doubt that they found the attractions much more than they imagined.

The important thing to remember when touring the Valley is to ensure that you take enough time to see all of the attractions. To do this you should obtain a brochure, which has a map outlining the main points of interest included in it. Any motel, hotel, restaurant or museum can supply you with such a brochure upon your arrival in the City. If you wish you can obtain one before you come by writing this Committee.

There are many things to see, and they are so varied we are sure you will find them all very interesting. Of these there are the Hoodoos, the Swinging Bridge, the two Museums, the Little Church, Dinosaur Burial Grounds, the magnificent views from Horseshoe and Horsethief Canyons as well as many, many other things to see and do. If you are like the other many thousands who come here these attractions will give you a most pleasant and enjoyable visit.

We hope you will find our Valley just as fascinating as it is to those of us who live here permanently. We are proud of our City and District and want to make it as attractive to visitors as possible. You can help us in this regard by letting us know if there is anything we can do to improve our facilities and attractions. Please write to: Chamber of Commerce, Tourist Committee, Box 203, Drumheller, Alberta.

EDUCATIONAL VALUE OF MUSEUM IMPORTANT

Inclusive in the over 68,000 persons who registered at the Drumheller Dinosaur and Fossil Museum in 1966, were over 4,000 students, members of youth groups, etc. and their teachers and leaders who, as well as the young people, were noticed taking notes to be used later in classrooms of universities and schools. The educational value of this museum cannot be overlooked. Groups numbering from 25 to 175 have attended the museum and we appreciate very much being notified in advance of proposed visits so that arrangements may be made to accommodate them.

* * * *

Added interest in the museum this year is the skull of a Pachyrhinosaurus and an ichnite, the foot imprint of an Edmontosaurus Duck Billed dinosaur, described on page 39.

* * * *

Many amusing incidents occur with small children. One little girl had seen the Calgary Stampede parade and upon her visit afterward, seeing the dinosaur skeleton mounted in the museum, said to her mother, "Oh, Mamma, look at the float", while another older child wanted to know if the skeleton was a boy or a girl.

* * * *

Air conditioning has recently been installed, which should add to the comfort of visitors and staff alike.

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By JIM FISHER, CJDV

Cinderella's story could have originated in Drumheller! It didn't, but, the good fortunes of the 1966 Canadian Senior Hockey Champion Drumheller Miners almost parallels the Cinderella saga.

Drumheller Miners, a community-operated organization, defied almost every pitfall imaginable, in capturing the highest honour bestowed within Canadian amateur hockey circles. The Allan Cup, emblematic of senior supremacy, is a fond dream of almost any hockey organization but, since the first competition won by Ottawa in 1908, few have sipped the fruits of victory from Sir Montague Allan's silverware.

The Miners' story goes back many years but the major developments began to unfold in the fall of 1965. Prospects were gloomy on the basis that a good number of new players had to be recruited from somewhere. The man credited with being the largest single factor in the Miners' success story, coach Roy Kelly, possessed a rare determination, a determination which turned virtual despair into what would soon place east-central Alberta and the Drumheller Miners' name into households of hockey fans around the world.

The vociferous Kelly went to work, plugging the numerous holes in an apparent sagging machine. If this wasn't enough, the home of the Miners was levelled by fire in October, 1965, just when the team was about to be assembled. Without a home to play in what was to be done, fold up? Undaunted by still another setback the club decided to forge ahead and with outstanding support of the public, were adopted by Hanna, an eastern Alberta town 45 miles distant.

Those critics, supposedly in the know, declared Drumheller faced an impossible task and would beat no one. Kelly's charges, known to play only at their own level, proceeded to win their first league title. Then, in the spring of 1966, the ten provinces of Canada proceeded to separate the men from the boys.

By the time the last competitive game of the 1965-66 season was completed (May 16, 1966 at Calgary) the Drumheller Miners had amassed one of the finest records in over half a century of senior hockey, culminated by the presentation of the Allan Cup, to the club operated out of the Drumheller Valley.

Club officials maintain the championship brought with it another "first". It is believed Drumheller, which had a population of only 3,500, was the smallest centre to ever win the title, in competition against the largest cities across Canada.

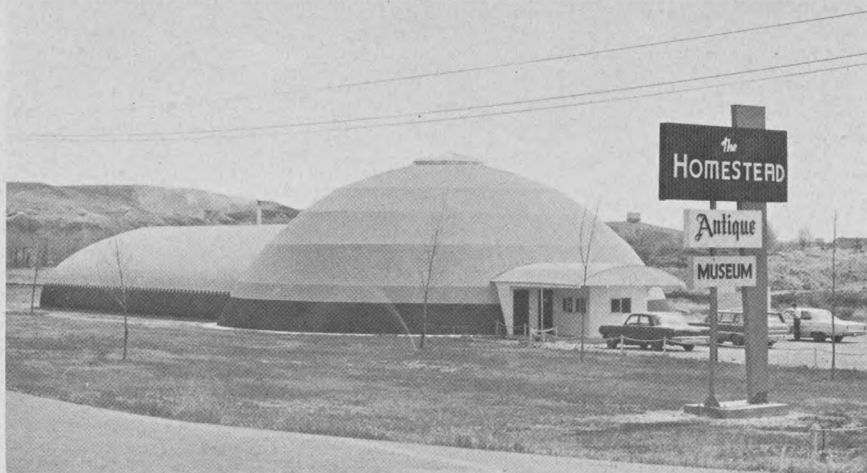
Accolades and bouquets were still flowing into the Valley of the Dinosaurs when a message from Montreal, Quebec (scene of the annual meeting of the Canadian hockey association) invited the Miners to represent Canada on a European tour. During the Christmas and New Year period of 1966-67, Drumheller placed eastern Alberta on the map, visiting communist East Germany, Sweden and Finland.

From such experiences an age-old motto again evolved: "Never give up, where there's a will, there's a way."

We now have two stories to tell—our prehistoric tourist attractions and the Drumheller Miners.

"THE HOMESTEAD" ANTIQUE MUSEUM

By BILL DOWSON AND FRANCIS PORTER



"The Homestead" is a must on your list of "sights to see" in the Drumheller valley. Located one-half mile west from No. 9 Highway on the Dinosaur Trail.

The Homestead is an eight-acre development immediately south of the Trail, dedicated to the preservation of the Big Country's interesting past. It can easily be recognized by the sign at the entrance to the property. The museum opened in June, 1965, welcomed some 15,000 visitors before closing for the season November 15th. This year some 5,000 sq. ft. of floor space has been added in order to provide room for the display of many more articles which have been acquired and are now in the collection.

The Homestead is the creation of a small group of local men who were interested in restoring, preserving and displaying articles from pioneer days to present and future generations. Working together in a group known as the Big Country Antique Museum Ltd. these men have been able to acquire hundreds of items and to display them for your interest and enjoyment at the Homestead.

A great deal of work has gone into the collection and restoration of the many articles on display at the Homestead and the men involved in this venture are kept busy the year round working on newly acquired items. After seeing those in the museum in operation, working in their homes and on their farms on articles intended for display at the Homestead, one can readily see that this is an institution that will continue to expand in the future as steadily as it has grown in the past.

Included in the display at the Homestead are early automobiles, steam and gasoline engines that rumbled across the Big Country many years ago breaking the sod on what was to become some of the best wheat growing country in North America. You'll see a wondrous array of firearms, rifles, shotguns and handguns. One of the finest collections in the world. Among this collection are revolvers that once swung from the hips of gunfighters, rifles that have killed buffalo, weapons that won the West rest alongside those once owned by long departed Redmen who tried to defend their country against the encroachment of the white man.

You will see the various instruments, machines and tools used in the coal mining industry which mined millions of tons of coal in this valley. The largest domestic coal field in the British Empire. The Homestead itself is sitting on top of the old Hy-Grade workings, formerly one of the largest mines in the valley.

The Homestead is probably the closest thing to a time machine you'll ever see. A stroll through the amazing collection of antiques will take you back through the years to the earliest pioneer days of this Big Country. You will see ancient farm and ranch implements, sleighs, wagons, and other means of travel that in days gone by carried laughing, singing families to spend an evening with the neighbors. You can see spinning wheels, washing machines, lamps, clocks, musical instruments, household furnishings. A wonderful collection of photographs from the early days of the Big Country. You can actually listen to old recordings played on the same machines that brought music into the pioneer homes.

For those who prefer things of a military nature there is an outstanding display of badges, medals, ribbons, weapons, and gear. Indian relics and artifacts are there for all to see.

Nearly every item in the Homestead is workable. As a matter of fact, if one of our older pioneers were to return to this earth, he would feel right at home at the Homestead on the Dinosaur Trail, surrounded by so many of the things he had in his own home so many years ago.

Your entire family will long remember your visit to the Homestead, for to step through the gate is to step back into time, to see and touch those things which belonged to the pioneers of the Big Country.

One visit will not be sufficient because the museum is a living, growing thing. Day by day the men who have brought into existence this project are adding to the display so that even though it may be old there will always be something new.

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APPRECIATION

The Badlands of the Red Deer River, 1967, the eleventh annual, is now in circulation. During the period the volume has increased from three to twelve thousand copies.

Thanks to the continued support and co-operation of the advertisers, Alberta Government Travel Bureau, Drumheller and District Museum Society, Alberta Tourist Association, City of Drumheller and others, who should receive much credit for the great increase in tourism.

The organizations and individuals supplying the reading material are to be congratulated. The contents are educational, interesting and creating a desire for tourists from Coast to Coast and many foreign countries to visit the Badlands.

The Circulation is wide spread as the Alberta Government Travel Bureau gives special attention to distribution outside the province including the U.S.A. The Alberta Tourist Association is showing wonderful results within the province. Registrations at the museum are showing many foreign visitors.

The advertisers appreciate having a booklet for their tourist customers interested in the pre-historic study. The mailing list has proven a very important factor.

The demand still exceeds the supply.

Thanks to all supporters.

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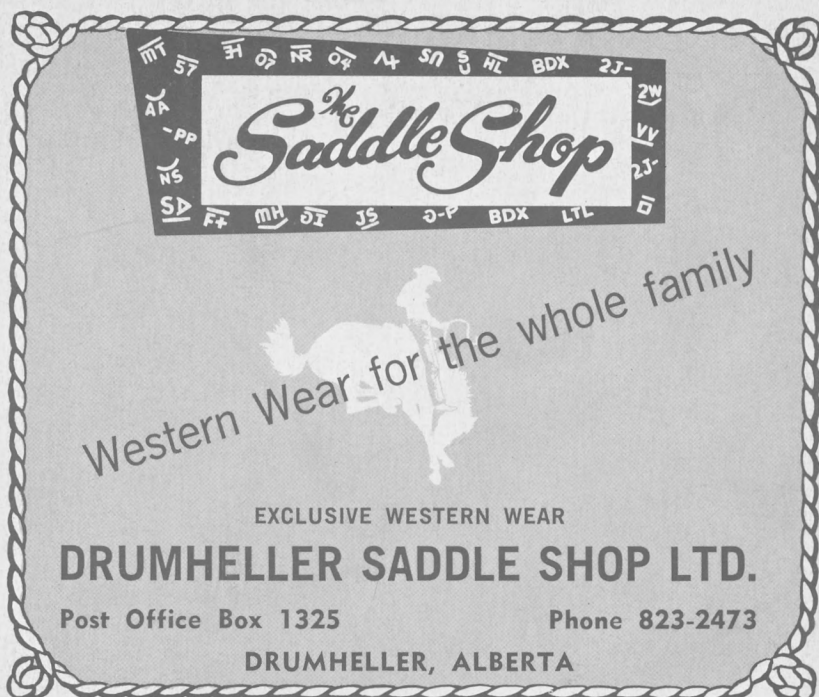
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